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APPLICATIONS OF TRAINING RESEARCH IN ARMY PILOT TRAINING DEVICE--ETC(U)
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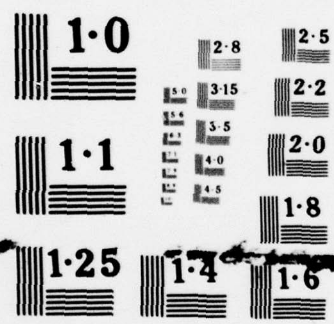

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Staff Paper

APPLICATIONS OF TRAINING RESEARCH IN ARMY PILOT TRAINING DEVICES

by

LTC Gordon C. Conklin
Dr. Paul W. Caro, Jr.
MAJ Victor J. Buttner

This Staff Paper has been prepared for dissemination within HumRRO for purposes of information or coordination internal to the organization. It does not necessarily represent official opinion or policy of either the Human Resources Research Office of the Department of the Army.

June 1968

HumRRO Division No. 6 (Aviation)

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE
operating under contract with
THE DEPARTMENT OF THE ARMY

ABSTRACT

The U. S. Army has a continuing interest in increasing the efficiency of its flight training. One means of improving flight training is the use of flight training devices and simulators. Four examples of flight training device research implementation are discussed. Emphasis is placed in these implementations on the utilization of knowledge of the principles of human learning behavior in the design and utilization of devices. Devices discussed include.

1. A 4/10-scale paper reproduction of the U-21 aircraft instrument panel and controls for use in the teaching of cockpit procedures;

2. A relatively inexpensive full-size cockpit procedures trainer for the U-21 aircraft;

3. A captive helicopter training device suitable for the teaching of hovering maneuvers, and

4. The Synthetic Flight Training System (SFTS), a system of helicopter instrument flight simulators embodying the latest training and hardware technology.

The nature of the helicopter training requirements at the U. S. Army Aviation School is discussed, as well as the critical need for more efficient training equipment.

Helicopter training
Training devices
Simulation
Fidelity of simulation
Automated training

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This paper is based on a briefing presented to Mr. N. G. Bittermann, Deputy Under Secretary of the Air Force for Manpower, at the Pentagon on 21 June 1968. The briefing was requested by Mr. Bittermann so that he and various DoD, USAF, USN, USMC, and USA personnel could be informed about Army flight training device research applications and the status of the Army's rotary wing Synthetic Flight Training System (SFTS). The nature of the helicopter training requirements at the U.S. Army Aviation School is discussed, as well as the critical need for more efficient training equipment.

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PREFATORY NOTE

This paper is based on a briefing presented to Mr. N. G. Bittermann, Deputy Under Secretary of the Air Force for Manpower, at the Pentagon on 21 June 1968. The briefing was requested by Mr. Bittermann so that he and various DoD, USAF, USN, USMC, and USA personnel could be informed about Army flight training device research applications and the status of the Army's rotary wing Synthetic Flight Training System (SFTS).

In addition to Mr. Bittermann, the following persons were in attendance:

MAJ Ralph E. Flexman, Office of the Deputy Under Secretary of the Air Force for Manpower

Dr. Ralph B. Canter, Office of the Assistant Secretary of Defense for Manpower and Reserve Affairs

COL James K. Johnson, Director of Individual Training (Acting), Manpower Planning and Research Office, Office of the Secretary of Defense for Manpower and Reserve Affairs

LTC Ben L. Harrison, Office of the Assistant Secretary of Defense for Manpower and Reserve Affairs

Mr. Edward A. Schroer, Office of the Assistant Secretary of Defense for Systems Analysis, Pilot Analysis Division

LTC Rodney D. McKitrick, Office of the Deputy Chief of Staff (Air), Technical Manpower Requirements Branch, U. S. Marine Corps

LTC Kyle W. Townsend, Office of the Deputy Chief of Staff (Air), Technical Manpower Requirements Branch, U. S. Marine Corps

Mr. Merle H. Gorder, Office of the Chief of Naval Operations

LTC James F. Smith, Director of Plans, Office of the Deputy Chief of Staff for Plans and Operations

LTC Robert Gerry, Office of the Deputy Chief of Staff for Personnel, Training Devices and Instructional Technology Division

The briefing was presented in three parts: LTC Conklin introduced the briefing proper; Dr. Caro discussed four specific examples of Army implementation of HumRRO training device research; and MAJ Buttner discussed the current status of the SFTS and the nature of the U. S. Army Aviation School's rotary wing training program. LTC Conklin represents the Chief of Research and Development, Department of the Army, in matters of human factors interest in Army training device developments. Dr. Caro has been responsible for the direction of HumRRO Work Units ECHO, ROTOR, and SYNTRAIN, which have been concerned with various aviation flight training device research problems. The content of his presentation is based on research conducted under these Work Units. Dr. Caro prepared the original statement of requirement for the SFTS at the request of the U. S. Army Aviation School. Since that time he has continued to work with various agencies in the development of the SFTS. MAJ Buttner is a member of the U. S. Army Aviation School Training Device Secretariat and is the School's project officer on the SFTS. In this capacity, he has represented the School to the various agencies involved in the SFTS development, particularly with respect to the detailed nature of the School's training requirement.

Training device research represents a major area of emphasis in HumRRO training research. This is reflective of the importance attached to such research and to the implementation of modern training technology by the U. S. Army.

APPLICATIONS OF TRAINING RESEARCH IN ARMY PILOT TRAINING DEVICES[1]

INTRODUCTION

LTC Gordon C. Conklin
Chief, Human Factors Branch, Behavioral Sciences Division,
Office of the Chief of Research and Development, Department
of the Army

Mr. Bittermann. Gentlemen.

I am LTC Conklin of the Office of the Chief of Research and Development, Department of the Army. The Army welcomes this opportunity to present to the Air Force information concerning some of its current research efforts in the field of aviation training devices and simulation.

The Army, as do all the services, is constantly seeking means to improve its training. The advent of hostilities in Southeast Asia and the new air assault concept of operations have lent further impetus to such efforts and have pointed up the need to augment our training capabilities for helicopter pilots. For a number of years the Human Resources Research Office of The George Washington University--better known as HumRRO--has conducted research on training and training device requirements under contract to the Army. HumRRO has carried out training device research studies in a variety of Army training situations. In many of those studies it was noted that the devices being utilized for training had become obsolete. Aviation was one such area in which device obsolescence was a significant problem.

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[1]The research described in this paper was performed at HumRRO Division No. 6 (Aviation), Fort Rucker, Alabama, under Department of the Army contract with The George Washington University; the contents of this paper do not necessarily reflect official opinions or policies of the Department of the Army.

For a variety of reasons--money and relatively simple aircraft, for example--the Army had not kept up with the aviation device state-of-the-art. The flight training devices we had were unsophisticated, and, by and large, were acquired from the other services. Some devices were being cannibalized in order to keep others in operation, because industry no longer made or stocked the spare parts for them. In the 1960s, however, Army aviation began to change markedly, in terms of both the size of the program and the complexity of its aircraft. It was with this background that HumRRO began its aviation training device research program.

HumRRO research indicated that in many training device areas industry was ahead of the services. For example, the airlines were using new techniques for their pilot training programs that were often superior to what the Army had to offer. One of the most notable such techniques was the use of flight simulators. By comparison, Army flight instruction was suffering.

The greatly expanding helicopter pilot training program led the Army to recognize that innovations were in order. Development efforts in the field of training devices and simulation were needed. Therefore, at the request of the U. S. Army Aviation School, the HumRRO Aviation Division prepared a Qualitative Materiel Requirement (QMR) for the Synthetic Flight Training System, commonly called the SFTS. Subsequently, the Chief of Research and Development directed that a Technical Development Plan be prepared to guide the future activities on the SFTS.

The major advances represented in the SFTS are, in reality, training technology advances, rather than hardware advances. Consequently, to make sure that the advanced training technology conceptions involved in the SFTS

are properly implemented in the design of the system, the Army has requested HumRRO to apprise the Chief of Research and Development of the progress of human factors and training technology activities. Specifically, Dr. Paul Caro, of the HumRRO Aviation Division at Fort Rucker, Alabama, who prepared the original QMR, carries out this responsibility for HumRRO. Dr. Caro will work closely with the intended users of the SFTS, as well as the developing agency, to insure that the system will meet the training requirements of the Army.

At this time, Dr. Caro will describe several examples of Army implementation of the results of HumRRO training device research, with emphasis on the SFTS. He, in turn, will be followed by MAJ Victor Buttner of the U. S. Army Aviation School, Fort Rucker, who will present a picture of just where we are in the SFTS development process and when we can expect the system to be implemented.

Dr. Caro.

TRAINING DEVICE RESEARCH: FOUR CASE STUDIES

Dr. Paul W. Caro, Jr.
Senior Scientist, HumRRO Division No. 6 (Aviation), Fort Rucker, Alabama

Until relatively recently, the Army had little requirement for synthetic flight training devices. During World War II and in Korea, Army aviation--and I am speaking of aviation elements that are organic to tactical field units rather than the Air Force types of units--operated out of areas adjacent to the Division's artillery units, and Army aviators flew aircraft, more reliable perhaps, but not much more sophisticated and often slower than their World War I counterparts.

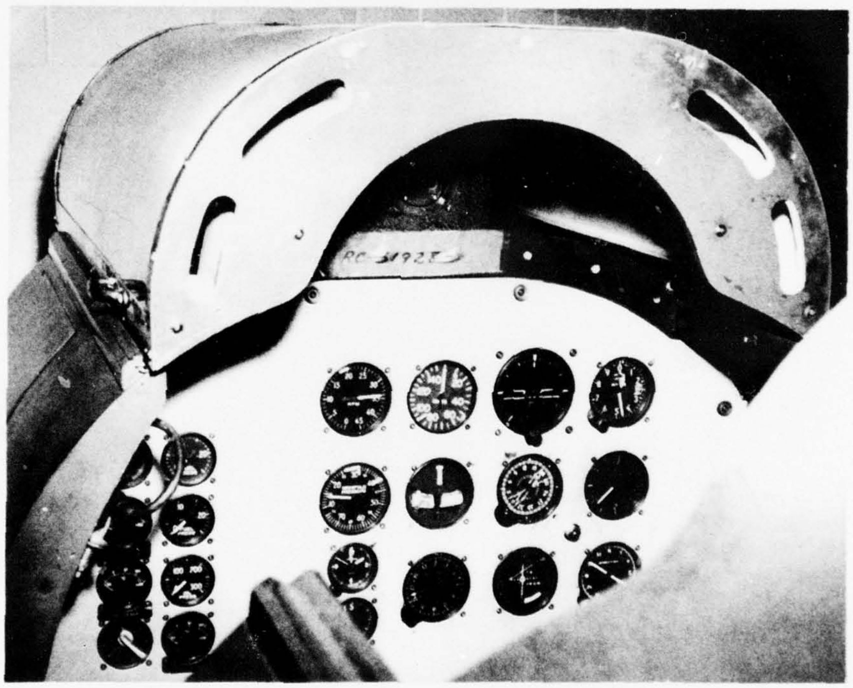
These aircraft were the L-4 Grasshopper during World War II and the L-19 Birddog in Korea. The L-4 was the military version of the Piper Cub, and the L-19, which is now known as the O-1, is a two-place, tandem-seat, tail-wheel aircraft first built in the early 1950s. The O-1 is similar to the Cessna-170, which through various changes (not the least of which was the replacement of the conventional landing gear with a tricycle gear) has led to the development of the T-41, the Army's and the Air Force's current primary fixed wing training aircraft. I might comment here that the Army's use of the O-1 constitutes one of the very few instances in which a U. S. military aviator has flown one and only one aircraft throughout his flight training and in the tactical environment.

With a requirement to train aviators to fly aircraft no more difficult to master than a primary trainer, there was little apparent need for synthetic flight trainers. The only use of such devices was in instrument training programs, but most of these programs were conducted under contract by civilian flying schools until about 1960. The Army used a few ANT-18 and 1-CA-1 Link Trainers during this early period, and these old "Blue Boxes" constituted the first real Army synthetic flight trainers. Their number was increased when, beginning in 1957, the Army acquired large numbers of cast-off Navy 1-CA-1s.

Slide 1

These cast-off Navy synthetic instrument flight trainers are still the most commonly found device in both Army fixed wing and rotary wing instrument training programs. They were modern devices twenty-five years ago, both in terms of engineering state-of-the-art and training technology. Since then

1-CA-1 INSTRUMENT FLIGHT TRAINER



Slide 1

considerable advancement has taken place in both these fields, and these advances are now beginning to be implemented in our newer synthetic flight training equipment.

Engineering technology developments tend to attract much more attention than do significant developments in training technology. The Army has added to its fixed wing synthetic trainer inventory another basic instrument trainer, the 2-B-12A, which incorporates modern engineering developments such as solid state electronics. Advances in training technology which date back more than 30 years, however, received little or no attention in either the design or utilization of this device.

It has been only during the past six or seven years that the Army has emphasized training technology in the design and use of synthetic flight training equipment. We will describe for you four training devices which incorporate design concepts which have grown out of training research conducted by the Army, by other government agencies, by private industry, and by academic psychologists during the past decade. The first two of these devices are procedures trainers; the third one is a tethered helicopter; and the fourth is not a device in the usual limited sense of the word, but rather is a system for training known as the Synthetic Flight Training System.

DEVICE NUMBER 1

We often mistakenly believe that effective training depends upon spending large sums of money or developing elaborate training equipment. Expensive and elaborate equipment certainly is required to accomplish some kinds of training, but many of the tasks that pilots perform can be learned to perfection without expensive, high fidelity physical, or engineering simulation.

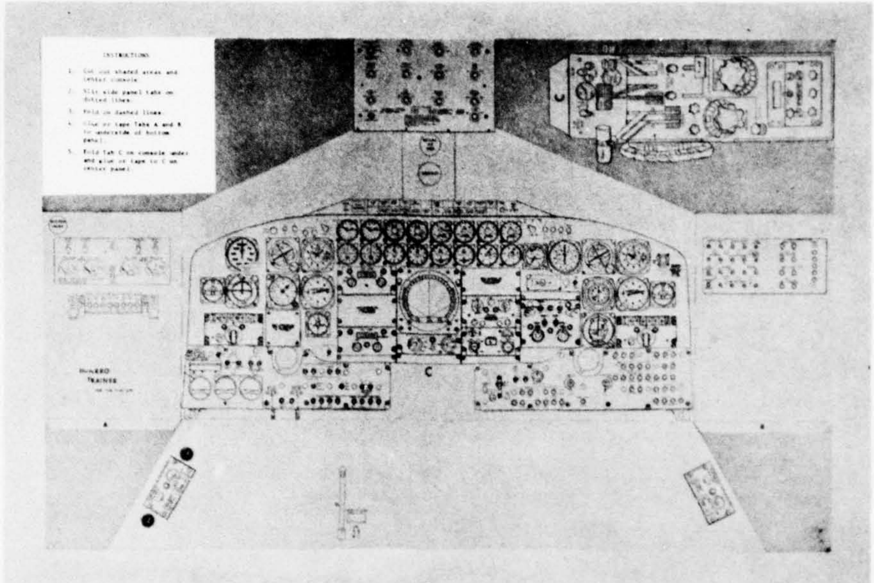
For example, training in procedural skills can be accomplished quite effectively using very low fidelity equipment, <u>so long as key task features are represented correctly</u>.

Recent research performed by several of the HumRRO Divisions--including studies of missile, armor, and aircraft systems--has dealt with the learning of fixed procedures such as those involved in start, run-up, and shut-down of aircraft engines. Transfer of training studies were conducted in which groups were trained not on operational equipment, but on plywood and photographic mockups, on reduced-size device facsimilies, and even on line drawings. The results showed that, regardless of such reductions in engineering fidelity, trainees who practiced only on the devices or drawings were just as proficient when they moved to operational equipment as were other trainees who received corresponding amounts of training using the operational equipment itself. Further, the skills acquired on the reduced fidelity training devices were retained just as well over time as were the skills acquired using the operational equipment.

These results have recently been implemented by the Army in a transition course for the U-21 Ute aircraft. The Ute is the Army version of the twin-engine, turbo-prop Beechcraft King Air. The first of the four devices I shall discuss, is a 4/10 scale U-21 procedures trainer made out of paper. We refer to it simply as the "paper trainer."

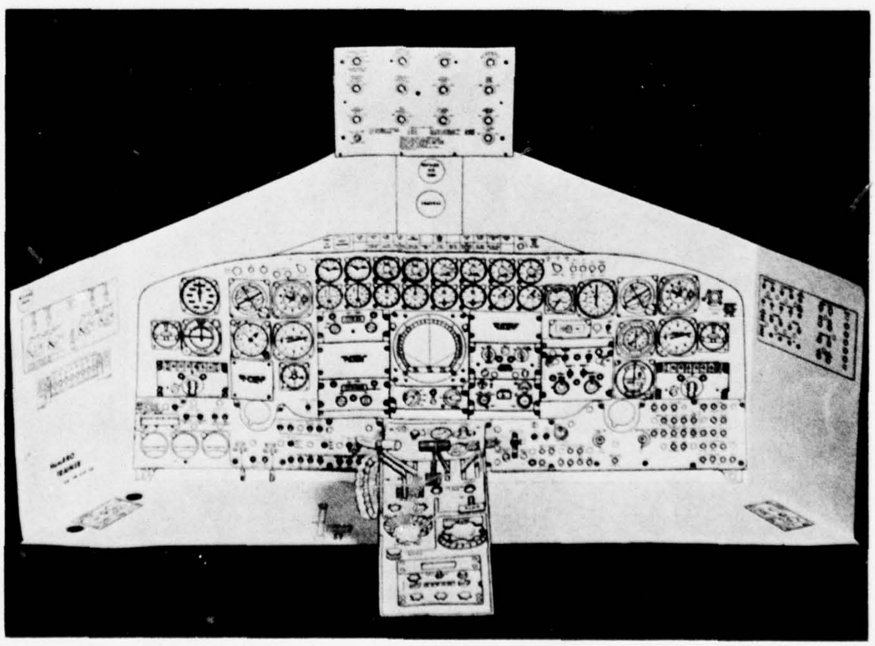
Slide 2

Using this device and a detailed program of instruction, a trainee is able to learn the name and locations of all the controls and displays in the U-21 aircraft <u>and</u> the procedures involved in all ground handling operations



Slide 2

PAPER TRAINER FOR U-21 AIRCRAFT



before he reports for his first flight training period. Since he receives his own retention copy of this trainer when he first signs in, along with the cut-and-paste instructions for assembling it, he has it available in his BOQ for reference throughout his attendance in the U-21 course. It cost the Army only a few cents per copy to give each trainee his own training device, one he can use whenever and wherever he wishes, and one requiring no instructor or other support.

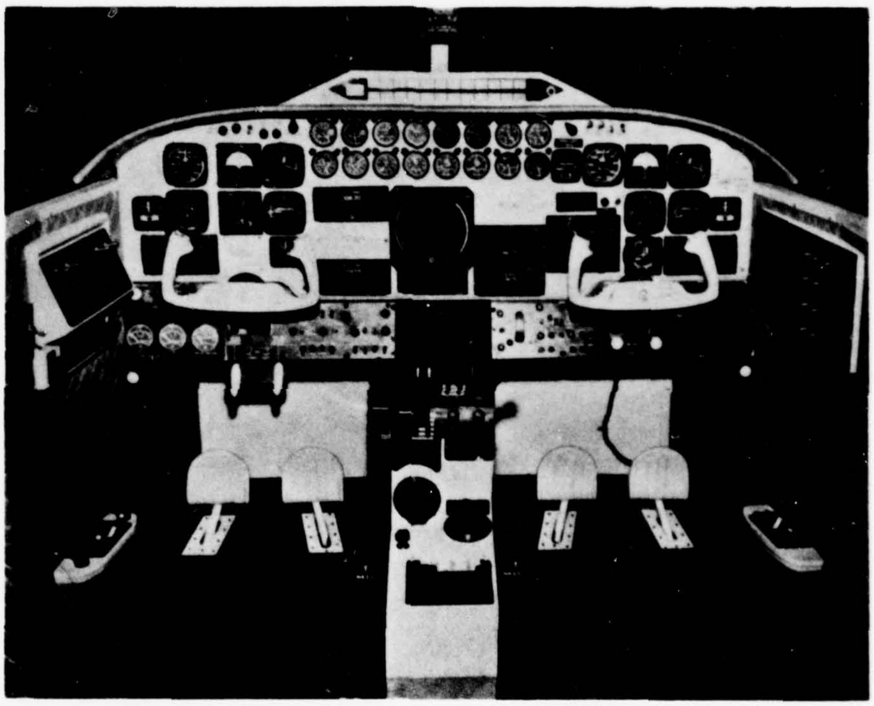
DEVICE NUMBER 2

As a practical matter, many trainees are not motivated to learn procedures thoroughly unless they are in a structured situation--such as with an instructor looking over their shoulder. For these trainees, further procedures training is needed. Therefore, another trainer was built which also capitalized upon the fact that elaborate simulation is not essential to assure transfer of training to operational aircraft.

Slide 3

This trainer differs from the paper HumRRO trainer in that it is a full-size replica of the cockpit of the U-21, so far as all controls and displays are concerned. It was built by the Army at Fort Rucker, to HumRRO design specifications at a cost, including parts and labor, of approximately $4,300. All the controls and all the displays in this device are operable. Switches on the instrument panel are wired directly to indicator lights, thus providing high fidelity to the simulation of about 2/3 of the aircraft responses involved in the procedures being learned.

U-21 COCKPIT PROCEDURES TRAINER



Slide 3

Simulation of system dynamics is provided for the remainder of the system by the use of two wet computers--the brains of the trainee and his instructor. Two techniques are employed. One is simply to have the instructor switch on or off various indicator lights in response to trainee operation of the appropriate controls. This technique is used where direct wiring could not be accomplished readily because of the complexity of the circuitry that would be required.

Meter movements presented a problem that was solved by the second technique, having the trainee manually set the needles to the appropriate values following or in coordination with his manipulation of the controls. For example, one step in starting an engine is to turn the ignition starter switch to the ON position. Upon doing this, the ignition indicator light comes on automatically, and the trainee manually moves the N_1 gas generator tachometer to 12% RPM. This procedure has several training advantages over the use of a procedures trainer that has full simulation of instrument readings provided by elaborate and expensive analog or digital computers.

First, the trainee must learn the specific gauges involved and the reading which should appear on each when he makes a control input;

Second, the instructor has immediate information that the trainee knows the correct gauge reading, and

Third, it is impossible for the trainee to perform the engine start by omitting such a step in the procedure to be learned without the error being obvious to the instructor.

While this deliberate use of interviewing trainee responses to provide dynamics is rather simple, there are relatively few examples elsewhere in flight training devices of similarly direct application of the knowledges we have acquired from non-device oriented training and learning research. One of the principles here, which was a part of the learning literature over three decades ago, is that procedural tasks are learned as behavior chains in which each response becomes the stimulus for the next response; that is, a response, the setting of the needle to the correct position, becomes the stimulus for the next activity, in this case, the advancement of the condition lever to low idle. Another important principle is that responses not necessary to a task tend to drop out without adverse effect on the overall task; that is, when the trainee transfers to the aircraft, his response of moving the needle will drop out automatically because it is no longer necessary, but the stimulus for the next action, an N_1 gauge reading of 12% RPM, will remain.

DEVICE NUMBER 3

The third device I want to describe today is even less conventional than a flight trainer made out of paper. It is an actual flyable one-man helicopter, mounted through an articulated linkage, on a ground effects machine platform. The platform provides a more or less frictionless base, and the device can move in all six degrees of freedom. Thus, a trainee using this device can execute all hovering maneuvers in safety. The trainee has solo control of the vehicle and communicates with the instructor via radiolink.

Slide 4

The training value of this device concept was subjected to experimental determination. Trainees were given an average 5-1/4 hours' training on the device before entering primary helicopter training. Their subsequent flight performance was compared with that of the control group members who did not receive such preflight training. The results of the comparison, shown on this slide, were surprisingly favorable to the device-trained group.

FLIGHT DEFICIENCY WASHOUT RATE
(Tethered Helicopter Device Study)

Group	Number of Trainees	Number of Washouts	Washout Percentage
Device	60	6	10.0
Control	57	17	29.8

Slide 5

The washout rate for unsatisfactory flight performance during the subsequent training was only 1/3 as high for the trainees who received training on the tethered helicopter device as it was for the control trainees. In addition, there were other advantages held by members of the device-trained group. They generally performed significantly better during the early stage of flight training, and they were able to solo the helicopter several hours earlier than the controls.

It should be noted that some of the advantages held by the device-trained group might be attributed to the manner in which they received such training as much as to the unique design features of the device. Two features of

CAPTIVE HELICOPTER HOVERING TRAINER

Slide 4

modern training technology were strictly applied: behavior shaping and proficiency based advancement. Behavior shaping is a technique of selectively reinforcing trainee responses until the desired skills are developed. For example, a trainee who moved the controls in the proper direction initially was reinforced for doing so. Then, only responses in the proper direction and of approximately the correct magnitude were reinforced. Finally, through successive approximations, he was reinforced only for more and more exact control manipulations until the desired skill was acquired. Behavior shaping was developed in the psychological laboratory and has found application primarily in animal training. It works equally well with aviator trainees, however.

Proficiency based advancement means systematically advancing trainees through a series of tasks of graded difficulty at a pace entirely dependent upon the rate at which they attain objectively-defined skill levels. It is a technique which has found wide application in programed instruction, but very little application in the development of skills such as those required for aircraft control.

DEVICE NUMBER 4

The fourth device is the Synthetic Flight Training System, which I shall refer to as the SFTS. The SFTS was conceived almost three years ago to meet the specific requirements of Army helicopter training, and its design followed a systematic study of the training requirements.

SYSTEM REQUIREMENTS FOR
SYNTHETIC FLIGHT TRAINING

1. Meet school and field training needs

2. Flexibility

   ✓ New aircraft
   ✓ New skills
   ✓ New training concepts

3. Instructional standardization

4. Quality control information

5. Maintenance of proficiency

6. Training innovation

Slide 6

This slide sets forth some of the general requirements which we felt the SFTS should meet. First, it was desired that it meet training needs of both the Aviation School and of Army units in the field. Second, the system should have flexibility to meet the changing requirements that would be posed by the new skills (for example, new tactics or operation of new equipment such as low-light level TV or armament systems), and the development of new training concepts such as computer-assisted instruction. Third, we felt the system should provide means for increasing standardization of instruction.

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Fourth, the SFTS should provide quality control information to School and other authorities which allows assessment of instructional efficiency and consequent instructional program modifications. Fifth, the system should provide an adequate means of maintaining proficiency in already acquired flight skills.

Finally, the SFTS should represent a real innovation in training. It should apply the latest state-of-the-art in training device design and training technology to Army aviation training problems. It should put the Army, as the principal using and training agency for helicopter pilots, at the forefront in training system development. We believe that the concepts embodied in the SFTS will allow the Army to achieve these not-so-modest, but most important, requirements.

Advances in the computer state-of-the-art in recent years have made the digital computer feasible for use and, in fact, make it much preferable over the analog computer for a development such as the SFTS. The digital computer has great advantages in reliability, maintenance costs, and most importantly, in flexibility.

The availability of appropriate digital computers, with their inherent flexibility, makes it possible to utilize a modular concept in the SFTS requirement. Thus, instead of separate individual trainers, the SFTS calls for computer modules, instructor station modules, cockpit modules, and motion system modules. This allows assembly of groups of appropriate modules into subsystem units designed to meet particular training requirements at the Aviation School and at various field installations.

The digital computer permits the capability of automating training. It will allow us to unburden the instructor of most of his routine duties and allow him to apply his talents to the critical individual student training problems. It will also allow one instructor to train three or four students simultaneously, thereby getting away from the costly one-to-one student-instructor ratio which has characterized synthetic flight training in the past. The SFTS also embodies a number of other training concepts such as automatic recording and evaluation of performance and adaptive training.

Slide 7

Here you see representation of the computer modules, the instructor station modules, and the cockpit and motion system modules for the Aviation School subsystem. To support the rotary wing training load, the Aviation School has stated an initial requirement for 31 UH-1 cockpit stations and one CH-47 cockpit.

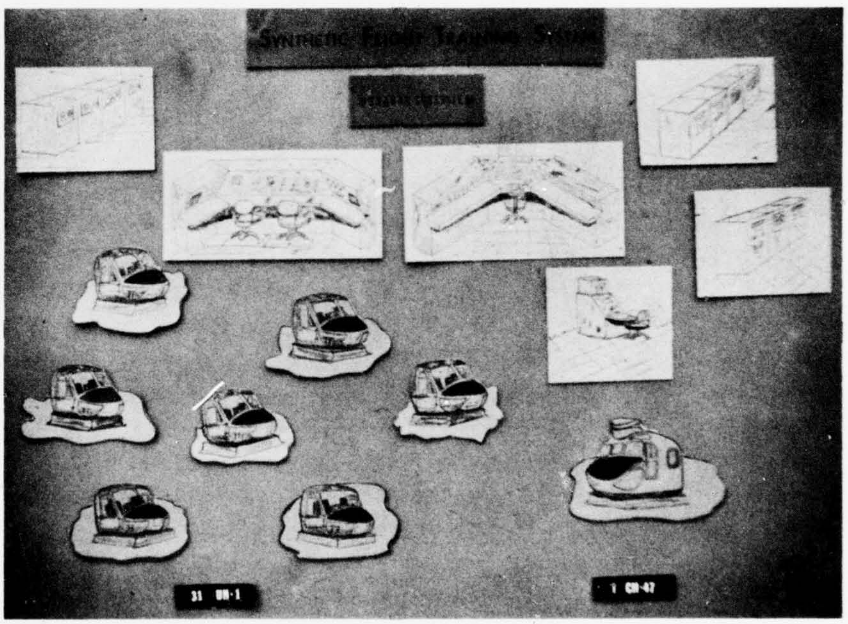
The subsystems for use with aviation field units would look much like this, except smaller numbers of cockpits and other modules would be involved, depending on local requirements.

With the great flexibility this system provides it will be possible in future years to add new aircraft or other components by merely adding the appropriate cockpit module and changing the computer program.

Slide 8

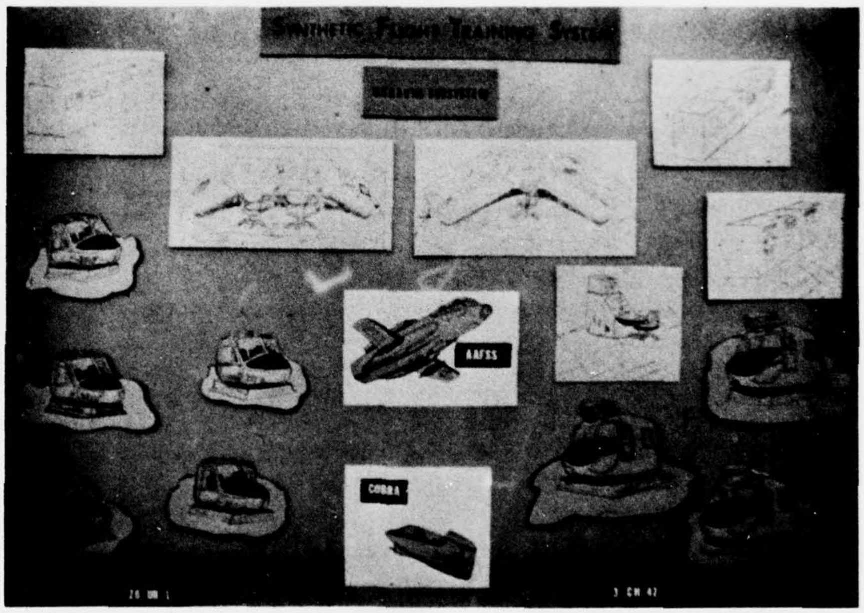
This slide depicts how the School subsystem might look several years from now as the training requirements have changed. The SFTS will allow for relatively easy integration of new aircraft, navigation, and weapons system simulation. Similar changes could be made in field unit subsystems.

SFTS
AVIATION SCHOOL SUBSYSTEM
(ARTIST'S CONCEPT)



Slide 7

POSSIBLE FUTURE CONFIGURATION OF SFTS



Slide 8

For the first time a training device system would exist which would be adaptable to changing needs over an extended period of time.

In the design of the SFTS and in the updating of the design which has continued since its inception, we have attempted to assure that developments in training technology have been implemented. I do not mean to suggest, however, that innovations in engineering have been slighted. We are making use of third generation digital computers, motion systems designed so that dimensions of motion may be added or deleted modularly as required for a specific application, cathode ray tubes with light pens and keyboards for updating the training situation on-line, and closed circuit television. However, the characteristics that make the SFTS the first of a new generation of synthetic flight training equipment are the training characteristics rather than the engineering characteristics. Literally, we are developing a training system, not just training equipment.

Let me describe some of these features. First, the instructor has been designed out of the system to the extent that it has been possible commensurate with cost effectiveness considerations. Routine instructor functions have been automated. It will be possible, for example, for a trainee to fly an instrument checkride, from take-off, through a series of navigation problems, including several instrument approaches to different facilities, to touch-down, while the instructor does nothing more than provide simulated radio communication from the various ground facilities involved in the problem. Throughout the checkride, the instructor will have real-time ground track, altitude, and airspeed displays; he will be alerted by a computer-generated display each time the trainee deviates from desired flight and

engine control parameters; and he will receive hard copy records of the trainee's performance, including procedural errors and response times, during all simulated emergencies.

Secondly, at the end of the checkride, data will be provided describing the trainee's performance and comparing it to School standards. These data will be presented graphically for easy use by School administration personnel in training quality control programs. In addition to automatically scoring checkride performance, the digital computer in the SFTS will be used to assist the instructor in the analysis of meaningful performance measures and criteria and to automatically score and sequence training problems. In this connection, I might note that the work on performance monitoring being done by the Behavioral Sciences Laboratory at Wright-Patterson Air Force Base has been particularly helpful.

An important instructor function which is being automated in the SFTS is the adjustment of problem difficulty to the individual level most appropriate for each trainee. The automation of this function has been made feasible by the development of adaptive training techniques. The technique involves increasing or decreasing the difficulty of the task being practiced in response to trainee performance. Thus, if a trainee begins to make too many errors, indicating that the task is too difficult for efficient training, task difficulty is decreased. Conversely, if the trainee is able to perform with few or no errors, the task probably is too easy for his skill level and is therefore increased in difficulty.

Adaptive training is an extension of programed instruction, but conventional non-adaptive programed instruction also is incorporated into the SFTS. Eventually, we hope that all of the programed instructional training in the SFTS will be made adaptive, but we do not have the techniques in hand that will allow full implementation of adaptive training throughout the system at the present time. The SFTS, of course, will facilitate the further development of these techniques.

Self-confrontation is another training concept that has recently been recognized as potentially useful in flight training. Self-confrontation allows the trainee, in a completely objective manner, to observe his own performance in a learning situation. It has been used widely in non-aviation training, and it is understood that the Air Force and a major airline have recently considered adopting the technique in pilot training programs.

Self-confrontation will be implemented in the SFTS in three ways. First, recordings will be made of simulated aircraft performance--or perhaps of trainee control input--for replay upon call. Thus, the trainee will be able to observe the autopilot flying the aircraft, but the flight he observes will in fact be a recording of his own performance which he can now observe and critique.

The two other means of implementation of self-confrontation involve the tape recording of radio transmissions and the video taping of trainee behavior as observed by the instructor via closed circuit TV. These are the techniques that have been used most often as teaching aids in past applications of self-confrontation.

Modeling or task demonstration is another technique of modern training technology that is being implemented in the SFTS. Using the three techniques involved in self-confrontation--playbacks of simulated aircraft performance, tape recordings of radio transmissions, and video recordings of trainee behavior--examples of desired or ideal performance will be presented to the trainee as a model to follow. In the case of modeling of simulated aircraft performance, a "slow-time" feature will be incorporated which will allow the instructor or the trainee to slow down the action for more detailed study. We believe this feature will be particularly useful in the study of maneuvers, such as an instrument take-off, where too much happens within a short time for an instructor to be able to point out all the complex interactions and control inputs that take place in real time.

One time-consuming instructor function which will be automated is the briefing of trainees on the day's training activities. This will be accomplished by the use of pre-recorded audio tapes, and where appropriate, these briefings will be synchronized with automated demonstrations of the maneuver to be performed. Not only does this relieve the instructor of a routine function, but it will contribute to more standardized training.

Debriefing following a period of training in the SFTS is not as amenable to automation, because the debriefing content largely is a function of the trainee's performance. Instead of attempting to automate this function, the instructor will be provided various aids so that he may debrief more efficiently. Debriefings may take place immediately following performance of a particular maneuver and while the trainee is still seated in the cockpit,

rather than being delayed until a coffee break or the end of a training period. The self-confrontation techniques will be valuable aids to the instructor during debriefing. In addition, the instructor's displays of ground track, procedural error, and other information may be displayed remotely to the trainee in the cockpit as a debriefing aid. During the debriefing, the instructor will be able to employ the pre-recorded models or any of the other automatic SFTS features to better assure trainee understanding of any problems which may have arisen.

As presently conceptualized, the SFTS is primarily a rotary wing training system. HumRRO recently completed a study of all major fixed wing pilot training programs at the U. S. Army Aviation School. Out of that study grew conclusions that the Army should develop SFTS subsystems for several of its advanced transition or graduate level courses. In addition, in the primary fixed wing training program, it was concluded that procurement of an off-the-shelf training device, one that presumably would have some of the training potential of the tethered helicopter training devices I described earlier, would be advantageous. Procedures trainers, similar to both the paper HumRRO trainer and the full-size replica of the U-21 cockpit, would provide beneficial training in a number of courses. Another conclusion has already been acted upon by the Aviation School. It is acquiring a commercially available twin-engine instrument trainer which is modeled after the T-42 Baron, the aircraft in which Army twin-engine qualification and fixed wing instrument training are conducted. We are working on a program of instruction for this trainer which will capitalize on all relevant recent developments in flight training technology. We anticipate that with such a program, it will

be possible to achieve a 50% reduction in the amount of flight training time required to meet present twin-engine qualification and instrument flight training proficiency criteria.

When we have obtained these fixed wing trainers and when the various subsystems of the SFTS have been delivered, the Army will no longer be conducting training in equipment designed for a World War II Navy requirement. The sophistication of our synthetic flight training equipment will be equal to the demands of our aircraft and their assigned missions. These devices, together with the Army's fleet of training aircraft and its modern classroom training capabilities will form an integrated training system designed for more efficient pilot training.

Procurement of the first subsystem of the SFTS is underway. MAJ Buttner, the SFTS Project Officer at the U. S. Army Aviation School, is going to tell you where we are at the present time in that procurement action and what is planned for the future.

THE SFTS AND ARMY AVIATION TRAINING REQUIREMENTS

MAJ Victor J. Buttner
SFTS Project Officer, Training Device Secretariat, U. S. Army Aviation School, Fort Rucker, Alabama

I am MAJ Buttner of the U. S. Army Aviation School's Training Device Secretariat and Project Officer for the Synthetic Flight Training System.

The Aviation School submitted the statement of requirement for the Synthetic Flight Training System in November 1965. After Army staffing and world-wide review, the requirement was approved by Department of the Army in April 1967. R&D funding was approved shortly thereafter, and the project was assigned to the Army Materiel Command's Participation Group at the U. S. Naval Training Device Center for study, development, and test model procurement.

Concept formulation studies, conducted independently by three major simulator manufacturers, were completed in April of this year. Each of the studies determined that the system is technically feasible in terms of its concepts and characteristics. They also made recommendations on technical specifications and on methods of implementing the training techniques which Dr. Caro described.

The study reports were used to assist in preparation of technical specifications for a four-cockpit field unit, the SFTS developmental model. Here is an artist's concept of such a field unit as visualized by one of the study contractors.

Slide 9

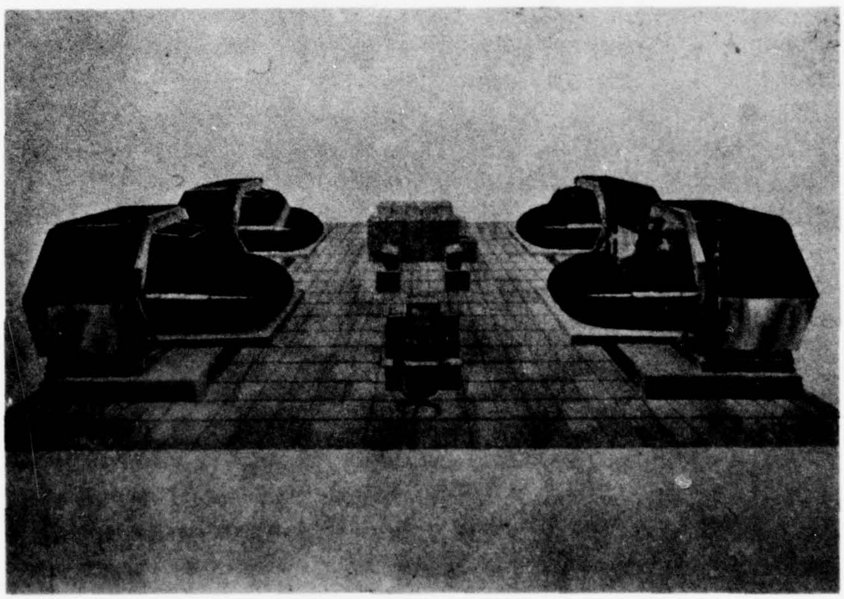
Specifications for the developmental unit are now undergoing Army review. When approved, they will provide the basis for a hardware contract to be awarded in the fall.

The design basis aircraft for the SFTS developmental model is the UH-1 Huey.

Slide 10

Development, delivery, and initial testing of the first unit are expected to be completed within 18 to 24 months after contract. The developmental model will be used to test the overall system concept; to evaluate demonstration, scoring, and adaptive training techniques; to determine the optimum ratios of synthetic to flight instruction; and to optimize the instructional programs to be used. Quantity procurement is anticipated following approval and type classification of the device.

PROPOSED CONFIGURATION OF
SFTS FIELD UNIT SUBSYSTEM



Slide 9

UH-1 AIRCRAFT

Slide 10

The Synthetic Flight Training System will contain three subsystems. The largest, located at the Aviation School, will be comprised of 31 UH-1 cockpits and one CH-47 Chinook cockpit.

Slide 11

The CH-47 will be the basis for the mobile subsystem which will be moved to various unit training locations as circumstances dictate. The third subsystem intended for use at permanent installations, is the UH-1 based field unit subsystem, the SFTS developmental model. Other aircraft will be added to the system as future requirements dictate.

The Aviation School's prime function is to provide well-trained aviators to Army field commanders. Our training requirement is to turn out sufficient quantities of combat ready aviators within a time frame which is responsible to Army needs. At present, we are graduating about 575 new helicopter pilots and 50 new fixed wing pilots per month.

The helicopter has become the Army's most versatile combat tool. It is the magic carpet of men and materiel which becomes the Skyhook for the artillery observer, the horse and saber of the cavalry, the on-top-of-the-action command post, the ambulance, messenger, rescue squad, and repair van. If the World War II Jeep has a Vietnam counterpart, it is the helicopter!

If versatile is an appropriate adjective for the Army helicopter, then it should also apply to the aviators who fly them. Their training must be comprehensive and efficient.

Shown here is the program for officers and Warrant Officer Candidates undergoing initial helicopter training. Initial fixed wing training is similar.

CH-47 AIRCRAFT

Slide 11

OFFICER/WARRANT OFFICER ROTARY WING
AVIATOR COURSE

Fort Wolters, Texas

Primary	8 weeks .	50 hours
Advanced	8 weeks .	60 hours

Fort Rucker, Alabama
or
Hunter Army Air Field, Georgia

Dept. of Rotary Wing Training:

Basic Instruments	4 weeks .	25 hours
Advanced Instruments	4 weeks .	25 hours
UH-1 Transition	4 weeks .	25 hours

Dept. of Tactics:

Advanced Tactics	4 weeks .	25 hours
	32 weeks .	210 hours

Slide 12

Commissioned officers, and enlisted Warrant Officer Candidates begin their flight training at the U. S. Army Primary Helicopter School, Fort Wolters, Texas. Officers will have already received branch training (Artillery, Infantry, Armor, etc.), and Warrant Officer Candidates will have previously undergone four weeks of preflight instruction, an intense period of OCS-like training.

The first 50 flight hours (two months) are spent acquiring basic flight skills in the TH-55 helicopter. Instruction in this phase is under civilian contract.

The trainee next receives 60 hours of flight instruction in Army OH-13 or OH-23 observation helicopters. He is introduced to formation flying, operation from tactical areas, basic visual navigation, etc. After completing this portion of this training he departs Fort Wolters for advanced training at either Fort Rucker, Alabama, or Hunter Army Air Field, Georgia.

The first month (25 flight hours) of advanced training, is devoted to basic attitude instrument flying. The student trains in an appropriately modified observation helicopter, learning to control the machine without outside visual reference.

This is followed by advanced instrument work (25 flight hours, one month) in which the trainee learns to plan, fly, and navigate under tactical instrument conditions. Emphasis is placed on use of radio beacons and GCA. We do not presently award these initial entry students a standard instrument card. Hopefully, the SFTS will enable us to do so.

The student's third month of advanced training (25 flight hours) is concerned with qualification in the UH-1. He is trained to operate from jungle clearings, hilltops, and rough terrain. He performs normal and emergency procedures while operating at gross weights up to maximum, day and night, at treetop height or traffic pattern altitude.

The final 25 flight hours are the most varied of all. Here the student applies the flight and academic training which he has received throughout the previous seven months. He practices gunnery, med-evac, troop transport, and resupply missions--all the "magic carpet" tasks. He learns to live and operate around-the-clock from a tactical field location. This final month of his training is as near the combat environment as we can safely make it.

Just prior to graduation the Warrant Officer Candidate receives his warrant officer bars, and then, with his class, he is awarded the aviation badge. School is followed by a month's leave and, most probably, a one-year combat tour. He will then likely return to one of the schools to instruct or for graduate training in more complex helicopters.

We will be ready and eager when the SFTS arrives. The need for training efficiency is obvious. The substitution of synthetic for flight training will also allow us more efficient utilization of those requirements specific to a training base. Space, time, facilities, personnel, equipment and money are all limited. The SFTS is a cost-effective answer to part of the training problem. The rest of the problem? We're working on that, too.